Final Project Report to the NYS IPM Program, Agricultural IPM 2003-2004.

Title:
Non-chemical control of root diseases in greenhouse grown cucumbers.

Project Leader:
Judson Reid, CCE Educator, Yates County

Cooperators:
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Type of grant:

Pheromones; biorationals; microbials; conventional pesticides

Project locations: NYSAES, Geneva, NY and Scenic View Farms, Ellis Rd. Dundee, NY. Findings could be applied nationally.

Abstract:
Greenhouse production of vegetables in the Finger Lakes region of New York State is growing exponentially. Yates County alone has seen a 1700% increase in farms growing edible greenhouse crops over the last 6 years. Ontario, Seneca, Steuben and Orleans are showing dramatic growth. Immigration of Old Order communities of Mennonite and Amish families is responsible for this revitalization of agriculture.
IPM is ideal for these greenhouses. Why?

- Old Order families use farm activities to be together. That means infants, children and parents work together in greenhouses.
- Vegetables are commonly grown in the same house as flowers. The two crops don't share pesticide registrations.
- Most growers desire low input approaches to agriculture.
- There are very few pesticides registered for edible greenhouse crops.

The goal of this project was to evaluate several beneficial microbial products for controlling damping-off, a common disease in these systems. Under grower conditions none of the products performed acceptably. At the New York State Agriculture Experiment Station Hydrogen Dioxide provided some disease control but was not equal to a fungicide. Future research could look at using Hydrogen Dioxide in combination with a microbial as an alternative to fungicides.

Background and justification:
Cucumbers were worth $20.1 million statewide in 2001. Of direct marketing farms nurseries and greenhouses had the highest value of direct sales with over $107 million.

Yates County has seen a 700% growth in greenhouse production over the last five years. As family size increases farmers are developing new greenhouses markets, such as cucumbers. There has been a 1700% increase in edible greenhouse crop production. Damping-off, at seedling and advanced growth stages, is a major constraint. To date very little IPM work has been done in greenhouse grown cucumbers in New York State. Last year the cooperating grower lost 80% of his cucumber crop to damping-off. The causal agent was diagnosed as Pythium spp. by the Abawi and Dillard labs. The grower produces many different crops in his greenhouse where his family works. A management tool for damping-off is sought that will be compatible with other vegetable and flower crops and present less danger to greenhouse workers. The project addressed stated commodity priorities 1 (Management of root zone problems), 3 (Biological control trials for efficacy and cost effectiveness) and 4 (Development of IPM strategies and resources for greenhouse crops including vegetable crops).

Objectives:

1) Evaluate economic return of biological controls.
2) Evaluate effectiveness of biological controls in damping-off suppression.

Procedures:

At Scenic View Farm, Dundee, NY:

March 21 5.5 grams of *Gliocladium harzianum* (Soilgard) were thoroughly mixed with 5000 ml potting mix in a plastic bucket. 1000 ml water were added.

March 25 5.5 grams of *Gliocladium harzianum* (Soilgard) were thoroughly mixed with 5000 ml potting mix in a plastic bucket. 1000 ml water were added.

March 25 10 cucumber seeds (var. Diva Hybrid, Gurneys) per flat were sown in two rows of 5 at a depth of .75". *Bacillus subtilus* (Companion) was applied at 1.5ml/L (label rate of 16 oz per gallon), to saturation point, (150 ml per pot). Hydrogen Dioxide (Oxidate) treatment was applied at a rate of 10ml/L (label rate of 1:100) to saturation point (150 ml per pot). *Trichoderma harzianum* (Plantshield) was applied at .4g/L (label rate of 5 oz per gallon) to saturation point (150 ml per pot). An uninoculated check was drenched with 150 ml water. *Gliocladium* treatments did not receive additional water.

Grower water/misted as need. Data collection began April 1.

At the New York State Agricultural Experiment Station:

Pythium ultimum isolates obtained from cooperating farmer during previous study.

July 2 green beans were chopped into 2-5 cm lengths and placed in petri dishes half filled with distilled water. These were autoclaved.

July 3 transferred 5 mm disks of 5 day old water agar cultures of *P. ultimum* isolates 1023, 1024, 1025, 1026 to 21 bean pod dishes each. These were placed in sterile boxes and wrapped in aluminum foil. New water agar cultures of *P. ultimum* were started. Prior to transfer each isolate was examined under a 10X scope for the presence of healthy spores.

August 4 5.5 grams of *Gliocladium harzianum* (Soilgard) were thoroughly mixed with 5000 ml sterile potting mix in a plastic bag. 1000 ml distilled water were added. Five other bags were prepared with equal amounts of potting mix and water. These were placed in a cooler.

August 6 Filled 42 seedling pots (7 treatments x 6 repetitions) and labeled soil for all 7 treatments.

August 7 All pots misted. Treated 4 grams of cucumber seeds (var. Diva Hybrid, Gurneys) at rate of 8 ml methylcellulose per .cwt and Apron 50W (Metalaxyl) at rate of 4 oz per .cwt. Seeds were allowed to dry before planting. All pots were seeded with two rows of 5 seeds Diva cucumber at a depth of.75”. An in-row drench of *P. ultimum* cultures from bean pods was applied at the rate of 1000 cfu/ gram of soil, approximately 5 ml of mixed solution from isolates 1023, 1024, 1025 and 1026. The untreated check was treated with 5 ml sterile distilled water. *Bacillus subtilus* (Companion) was applied at 1.5ml/L (label rate of 16 oz per gallon), to saturation point, (150 ml per pot). Hydrogen Dioxide (Oxidate) treatment was applied at a rate of 10ml/L (label rate of 1:100) to saturation point (150 ml per pot). *Trichoderma harzianum* (Plantshield) was applied at .4g/L (label rate of 5 oz per gallon) to saturation point (150 ml per pot). Inoculated and uninoculated checks were drenched with 150 ml sterile distilled water. Metalaxyl and *Gliocladium* treatments did not receive additional water. Seedling rows were covered and pots placed in growth chamber at 21°C, 12hr photoperiod.

August 8 150ml of 1:100 dilution Hydrogen Dioxide applied to respective pots in each rep. Other treatments misted.

August 9 150ml of 1:100 dilution Hydrogen Dioxide applied to respective pots in each rep. Other treatments watered.

Data collection began on August 14.

Results and discussion:

No significant differences between treatments were observed at cooperating grower’s greenhouse. Observe figure 1, average final stand counts per treatment for the Dundee site.

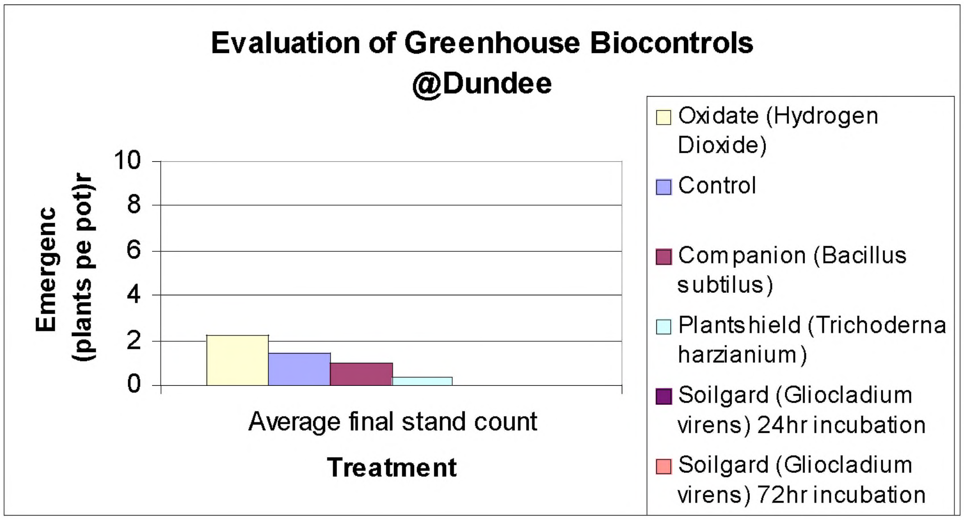


Figure 1. Final stand counts at Dundee cooperating site. There was no statistical difference between any treatment.

A 72 hr incubation of Soilgard was included per label instructions that product should incubate 24-72 hours. Gliocladium produces gliotoxin (Lumsden et al), which inhibits Pythium spp., but the 72 hr incubation was not significantly different from the 24 hr incubation. This site had tremendous disease pressure.

Data from the NYSAES trial had more significance.

Table 1. Mean and LSD of final stand counts at NYSAES

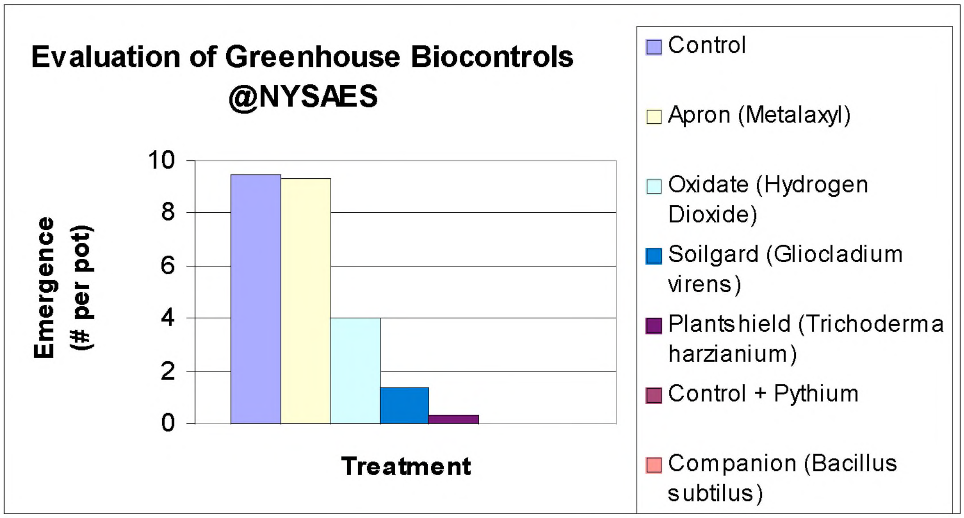
Final Stand Counts

Means with same letter are not significantly different

Treatment	Mean	Grouping
Control	9.5	A
Apron (Metalaxyl)	9.3	A
Oxidate (Hydrogen Dioxide)	4	B
Soilgard (*Gliocladium virens*)	1.3	C
Plantshield (*Trichoderma harzianum*)	0.3	C
Companion (*Bacillus subtilus*)	0	C
Control + Pythium	0	C
LSD ($P \leq 0.05$)	*2.1 LSD*	

*Means with different letters (grouping) differ significantly according to Fishers Protected LSD ($P \leq 0.05$)

Figure 2. Mean final stand counts at NYSAES.



The seed treatment of Metalaxyl was significantly greater than all other treatments, with the exception of the uninoculated check. Hydrogen Dioxide treatments had significantly superior stand counts than all microbials but at a mean unacceptable to commercial crop production. None of the microbials were significantly different from Pythium inoculated check.

Worth noting is the variability of Hydrogen Dioxide, with the highest final stand count in one rep of 10 seedlings and 0 seedlings in another rep.

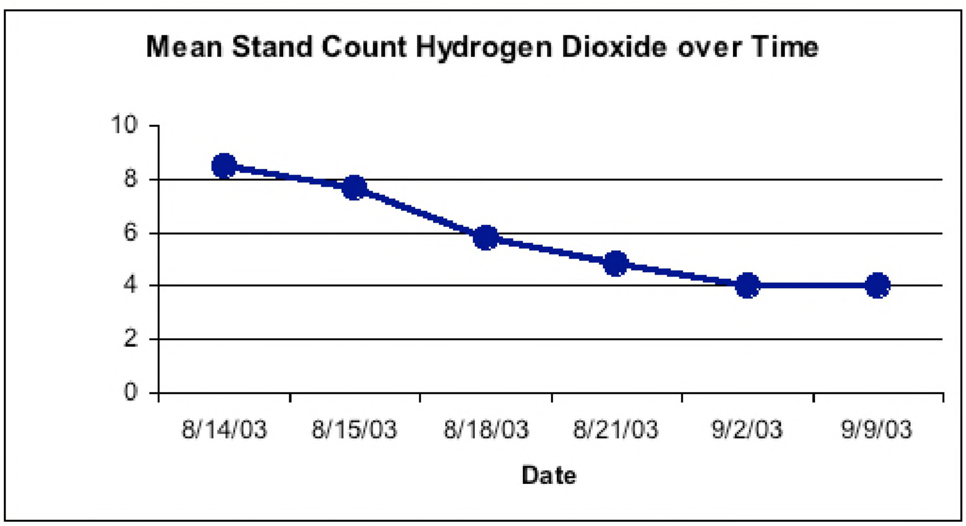


Figure 3. Mean stand count for Hydrogen Dioxide over time.

Hydrogen Dioxide's mean stand count for the first date is significantly similar to the fungicide standard and uninoculated check. Could this stand count be maintained if follow up applications were made?

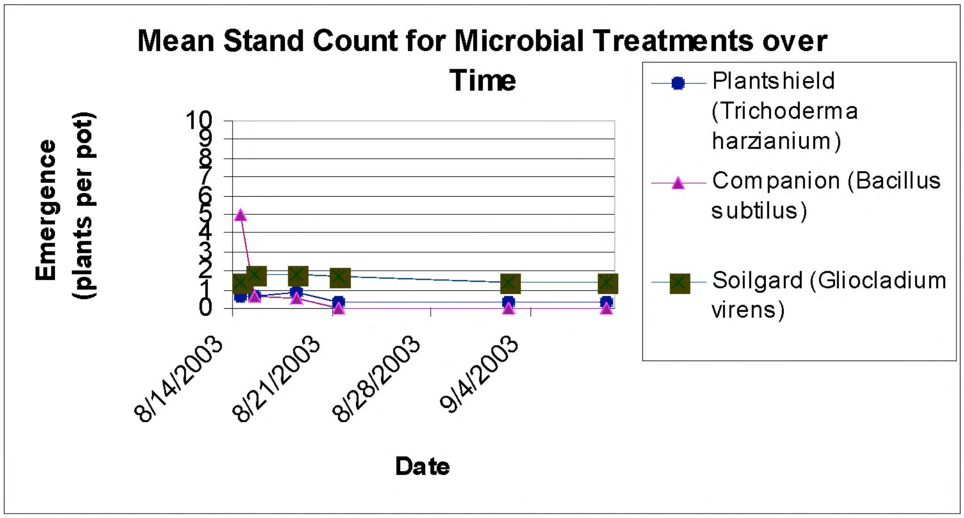


Figure 4. Mean Stand count for *Trichoderma, Bacillus* and *Gliocladium* treatments over time. Results were not significantly different.

Economically the microbial products provided no economic return in either Dundee or NYSAES as emergence was not significantly different from Pythium inoculated controls.

The results of this trial were presented to over 50 greenhouse growers (both flower and vegetable producers) at the Finger Lakes Produce Auction on December 11, 2003. Photos from the trial and data were included in a power point presentation on IPM of Soilborne Diseases in Greenhouse Crops. Many growers requested copies of the presentation and encouraged further research. 2 DEC pesticide applicator recertification credits were awarded.

Anecdotally, during the 2003 growing season I consulted with several growers who had late damping-off in greenhouse vegetables. Lab analysis of the pathogen determined it to be Pythium spp. Working together with the growers we decided to apply Hydrogen Dioxide as a curative. Treatments were followed 24 hrs later with the introduction of a microbial product. The problem was corrected and one grower escaped major losses. Further research could formally test a combination of Hydrogen Dioxide with beneficial inoculation as an alternative to fungicides.

New interpretation of NYS pesticide law allows greenhouse vegetable growers to use field chemicals. To prevent industry reliance on pesticides, it is important to continue this research to evaluate if Hydrogen Dioxide, when followed with a microbial could be an IPM alternative for greenhouse vegetables.

References:

Lumsden, R.D.; Lewis, J.A. Locke, J. C. 1993. Managing Soilborne Plant Pathogens with Fungal Antagonists. In Pest Management: Biologically Based Technologies. Lumsden, R.D. and Vaughn, J.L. eds. Proceedings of Beltsville Symposium XVII, Agriculture Research Service. U.S. Department of Agriculture, Belstville Maryland, May 2-6 1993, American Chemical Society, Washington, D.C.

Samples of materials:

Figure 5. Photo of rep 3 on 8/18/3

Figure 6. Photo of rep 1 on 8/21/3. Note late damping-off in 1O (Oxidate)

Figure 7. Photo of greenhouse cucumbers and tomatoes in Dundee.

Figure 8. Photo of late damping-off of greenhouse cucumbers.